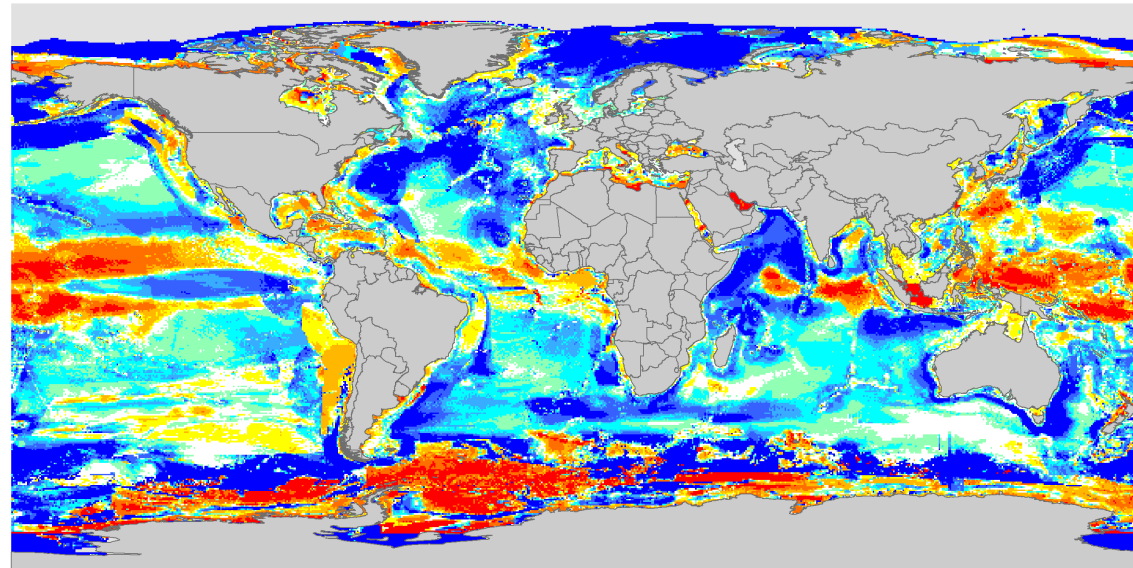




NOAA
FISHERIES

Southwest Fisheries
Science Center
Environmental Research
Division

2.13 Climate Change Vulnerability Studies: GROUNDFISH, CPS AND HMS CLIMATE VULNERABILITY STUDIES



Change in catch potential
(% relative to 2005)



Cheung et al. (2009)

Q1, Q2, Q4, Q5, Q7, Q8

CLIMATE VULNERABILITY STUDIES

- NOAA Climate Vulnerability Assessments
 - National effort to assess vulnerability of NMFS-managed fish stocks in each Region
- Climate Change Impacts on CPS Fish and Fisheries in the California Current
 - Assess potential range shifts and impacts on coastal communities
- Climate Projections of HMS Habitat Changes in the North Pacific
 - Use tracking + remote sensing + climate models to assess habitat change
 - Projected changes in North Pacific top predator biodiversity
- Science & Management Advances
 - Next steps

CLIMATE VULNERABILITY ASSESSMENTS: *THE NATIONAL PROCESS*

Goal:

Produce a practical and efficient tool for assessing the vulnerability of a wide range of fish stocks to a changing climate.

Objectives:

1. Provide relative vulnerability rankings across species (**triage**)
2. Identify key attributes/factors driving vulnerability
3. Identify key data gaps or information needs
4. Advance the conversation about research needs and management options at Regional/Council level
5. Develop partnership with NOAA OAR to synthesize climate projections needed for analysis



CLIMATE VULNERABILITY ASSESSMENTS: *THE NATIONAL PROCESS*

Climate Vulnerability Assessment Process

1 Scoping and Planning

- Engage with partners and stakeholders
- Define scope:
 - Study Area
 - Stocks
- Identify regional climate factors
- Identify and task leaders, staff, and experts

2 Assessment Preparation

- Compile:
 - Species profiles
 - Climate projections
 - Distributional information

3 Scoring

- Train experts (webinar)
- Perform preliminary scoring (individuals)
- Compile preliminary results
- Discuss results (workshop)
- Complete final scoring

4 Results

- Compile:
 - Tables and figures
 - Sensitivity analysis
 - Draft Reports
 - Species vulnerability narratives
- Submit to internal and peer review

5 Communication

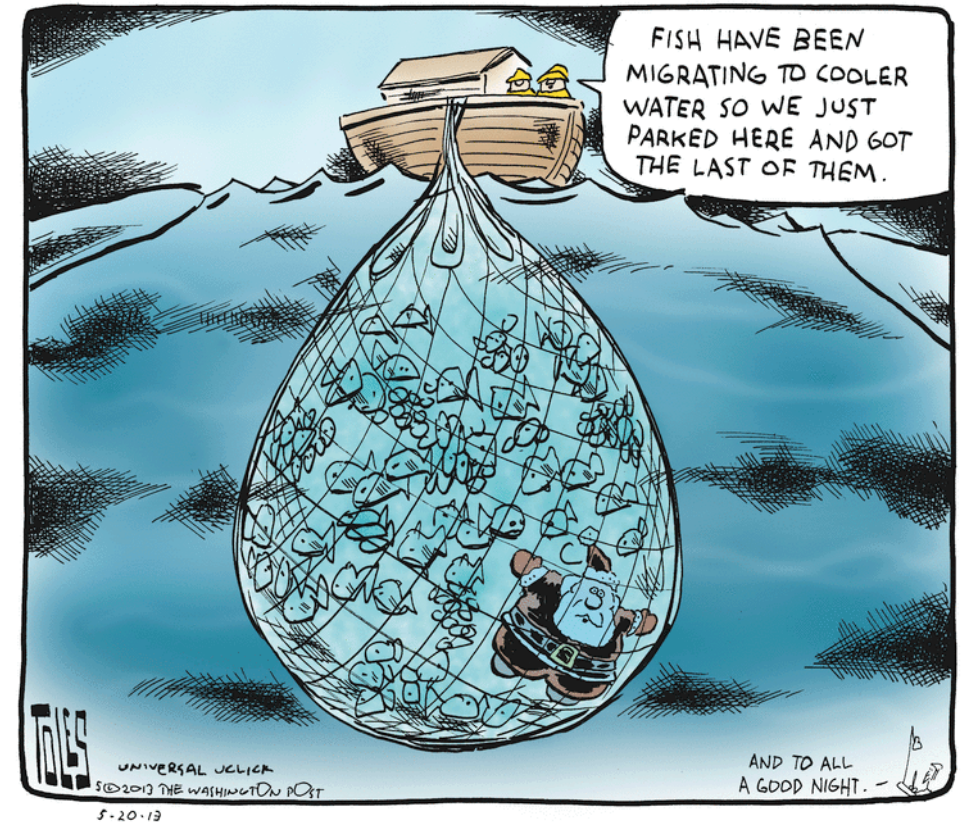
- Engage with stakeholders
- Identify key climate vulnerability drivers
- Identify important data gaps
- Develop science priorities
- Investigate management options
- Develop adaptation strategies
- Update assessment as needed

WEST COAST FISHERIES CLIMATE VULNERABILITY ASSESSMENT

62 Species [Groundfish, CPS, HMS, Salmon]

Sensitivity Attributes:

- Habitat Specificity
- Prey Specificity
- Adult Mobility
- Dispersal of Early Life Stages
- Early Life History Survival
- Complexity in Reproductive Strategy
- Spawning Cycle
- Sensitivity to Temperature
- Sensitivity to Ocean Acidification
- Population Growth Rate
- Stock Size/Status
- Other Stressors

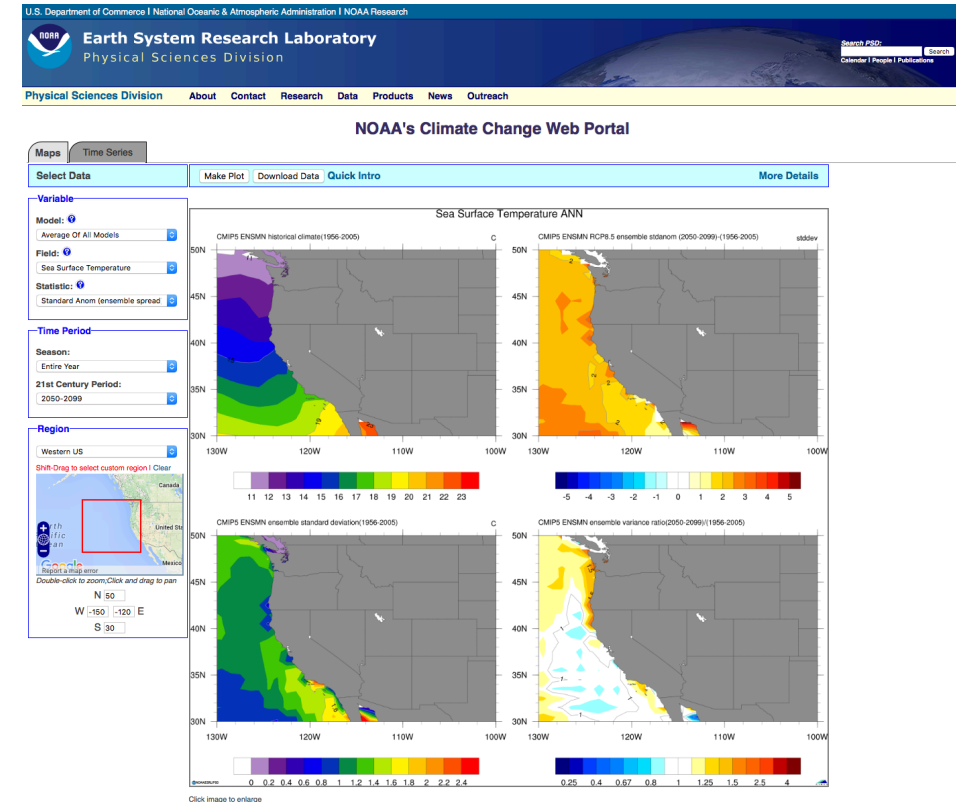


WEST COAST FISHERIES CLIMATE VULNERABILITY ASSESSMENT

62 Species [Groundfish, CPS, HMS, Salmon]

Climate Exposure Factors:

- Air Temperature
- Sea Surface Temperature
- Salinity
- Ocean Acidification
- Winds (alongshore wind stress)
- Precipitation
- Sea Level Rise
- Subsurface Oxygen
- Upwelling Phenology
- Δ Mean, Δ variance for all variables



NOAA Climate Change Web Portal (NOAA-OAR-ESRL)
<http://www.esrl.noaa.gov/psd/ipcc/>

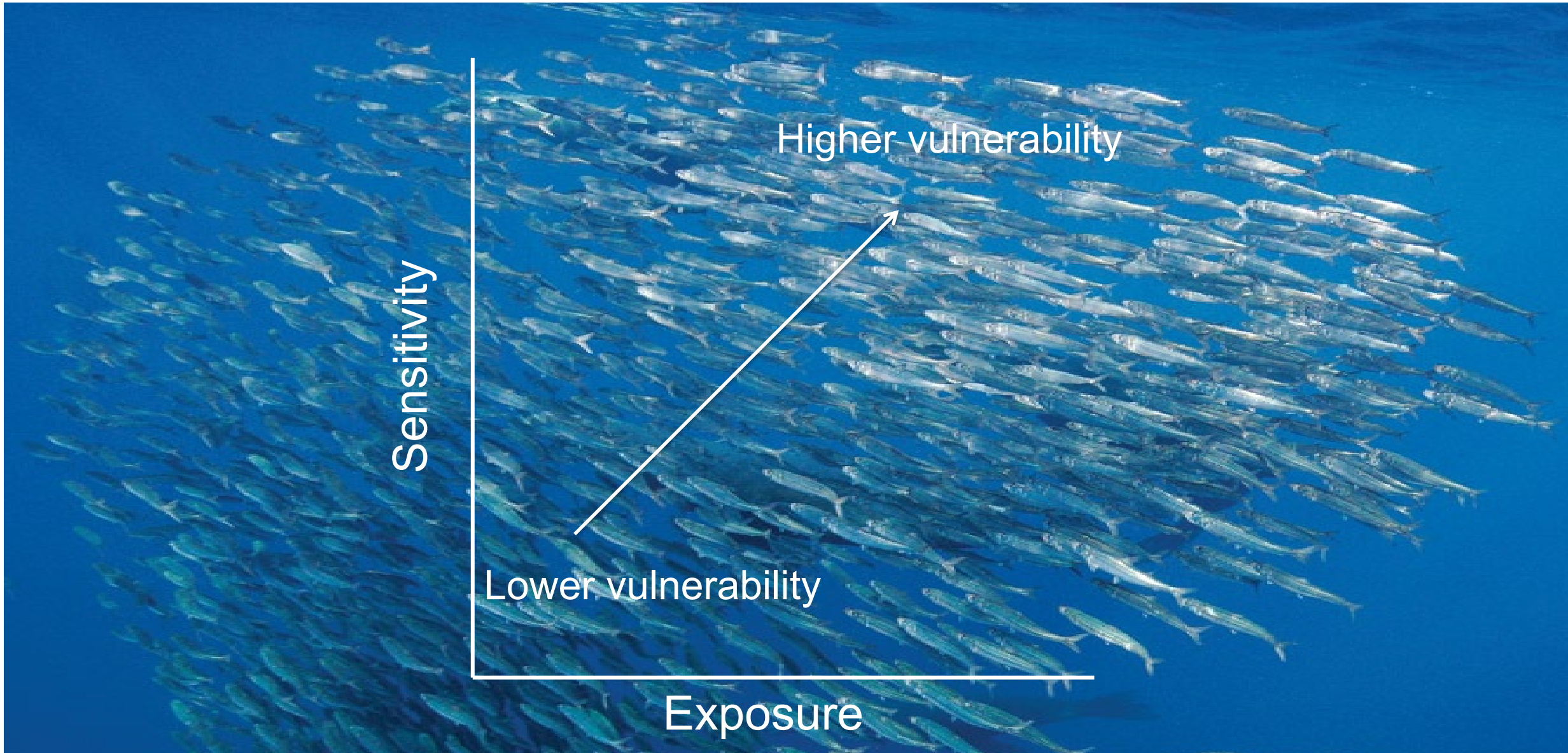
WEST COAST FISHERIES CLIMATE VULNERABILITY ASSESSMENT

- Experts identified and undergoing scoring process
 - NOAA (NWFSC, SWFSC) and Academic (UC-Davis, UC-Santa Cruz, Oregon State, U. South Carolina)
 - Experts in fisheries biology, oceanography, climate
- “WEST COAST CLIMATE VULNERABILITY ASSESSMENT FOR MARINE AND ANADROMOUS FISH” Workshop
 - April 26-28th in Monterey, CA
- Final assessment to be completed by September 2016

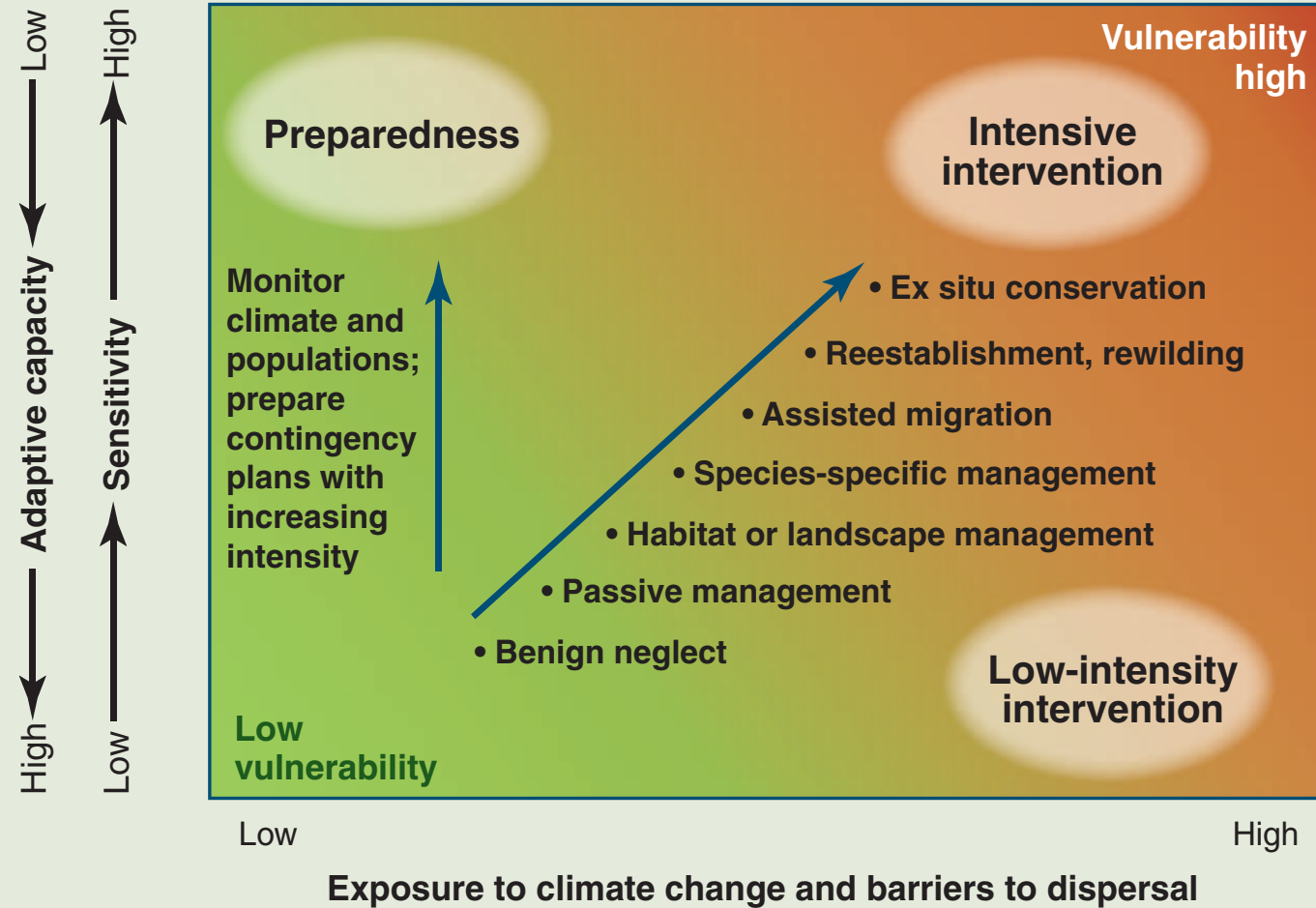
COASTAL PELAGIC SPECIES CLIMATE VULNERABILITY IN THE CCLME



COASTAL PELAGIC SPECIES CLIMATE VULNERABILITY IN THE CCLME

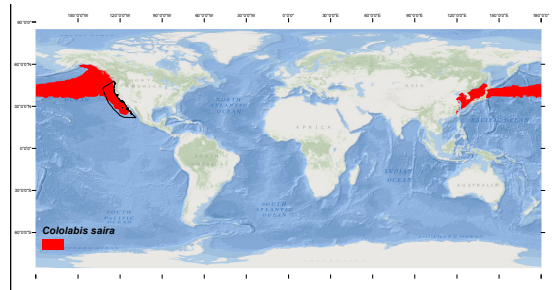


COASTAL PELAGIC SPECIES CLIMATE VULNERABILITY IN THE CCLME



COASTAL PELAGIC SPECIES CLIMATE VULNERABILITY IN THE CCLME

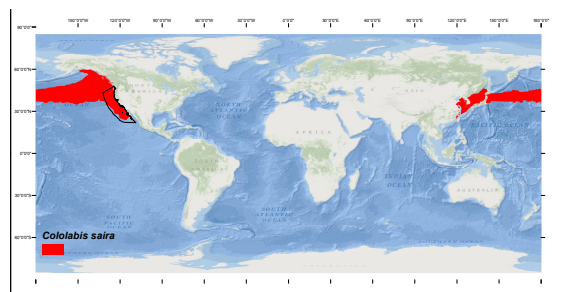
1 Define present day species distributions



10 species
AquaMaps

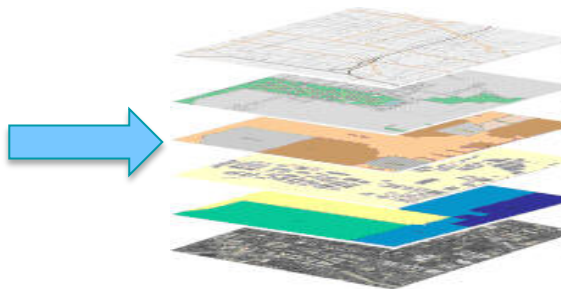
COASTAL PELAGIC SPECIES CLIMATE VULNERABILITY IN THE CCLME

1 Define present day species distributions



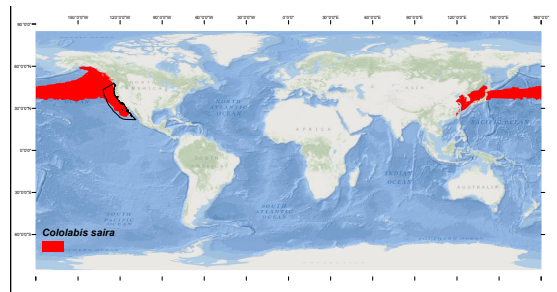
10 species
AquaMaps

2 Establish current climatic conditions



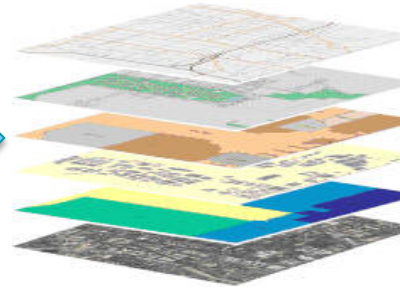
COASTAL PELAGIC SPECIES CLIMATE VULNERABILITY IN THE CCLME

1 Define present day species distributions

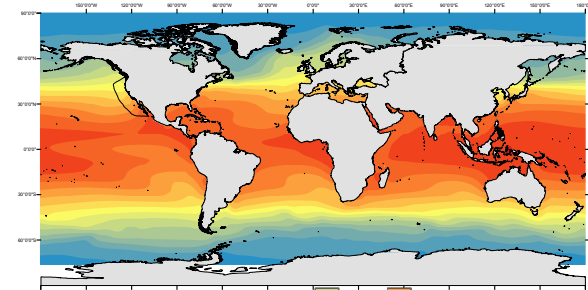


10 species
AquaMaps

2 Establish current climatic conditions



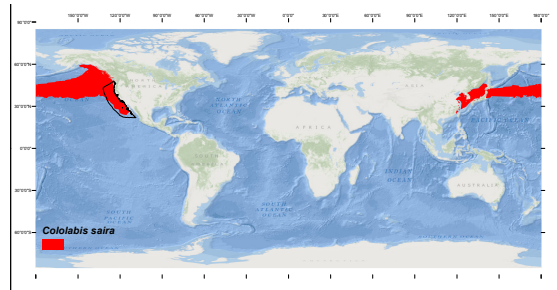
3 Predict future climatic conditions



NOAA GFDL ESM2G rcp8.5
Dunne et al. (2012)

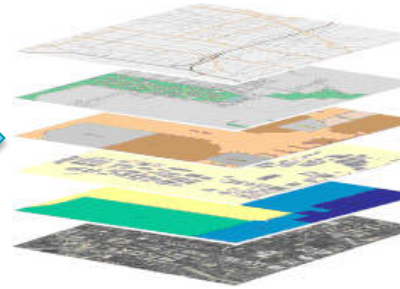
COASTAL PELAGIC SPECIES CLIMATE VULNERABILITY IN THE CCLME

1 Define present day species distributions



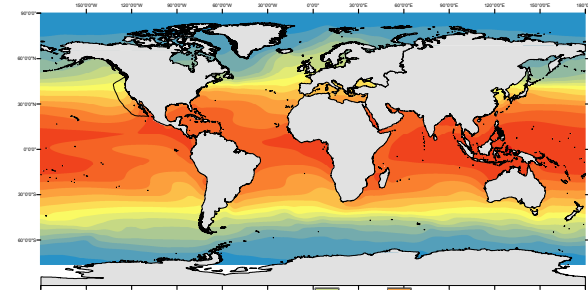
10 species
AquaMaps

2 Establish current climatic conditions

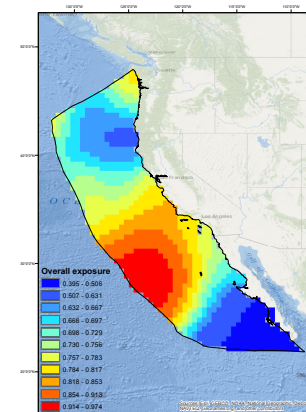


NOAA GFDL ESM2G rcp8.5
Dunne et al. (2012)

3 Predict future climatic conditions

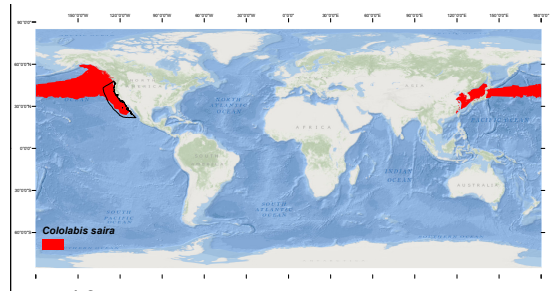


4 Estimate exposure based on expected change in climate



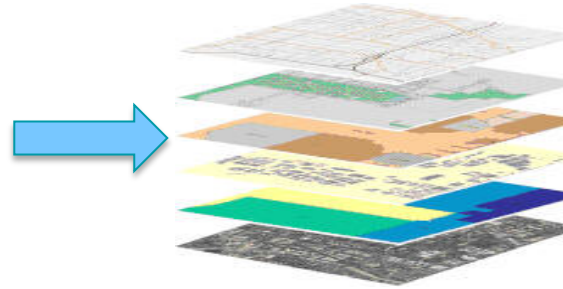
COASTAL PELAGIC SPECIES CLIMATE VULNERABILITY IN THE CCLME

1 Define present day species distributions

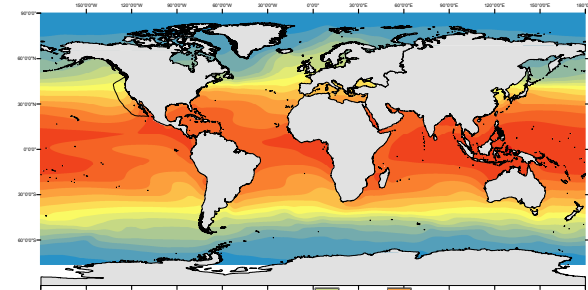


10 species
AquaMaps

2 Establish current climatic conditions



3 Predict future climatic conditions

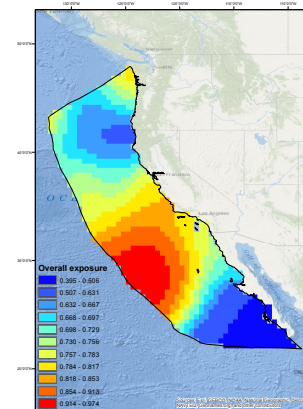


NOAA GFDL ESM2G rcp8.5
Dunne et al. (2012)

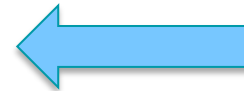
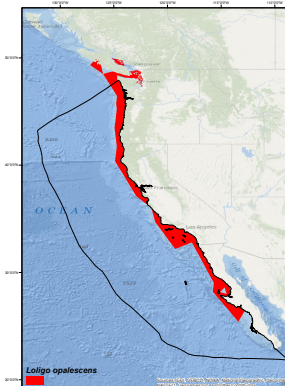


4

Estimate exposure
based on expected
change in climate

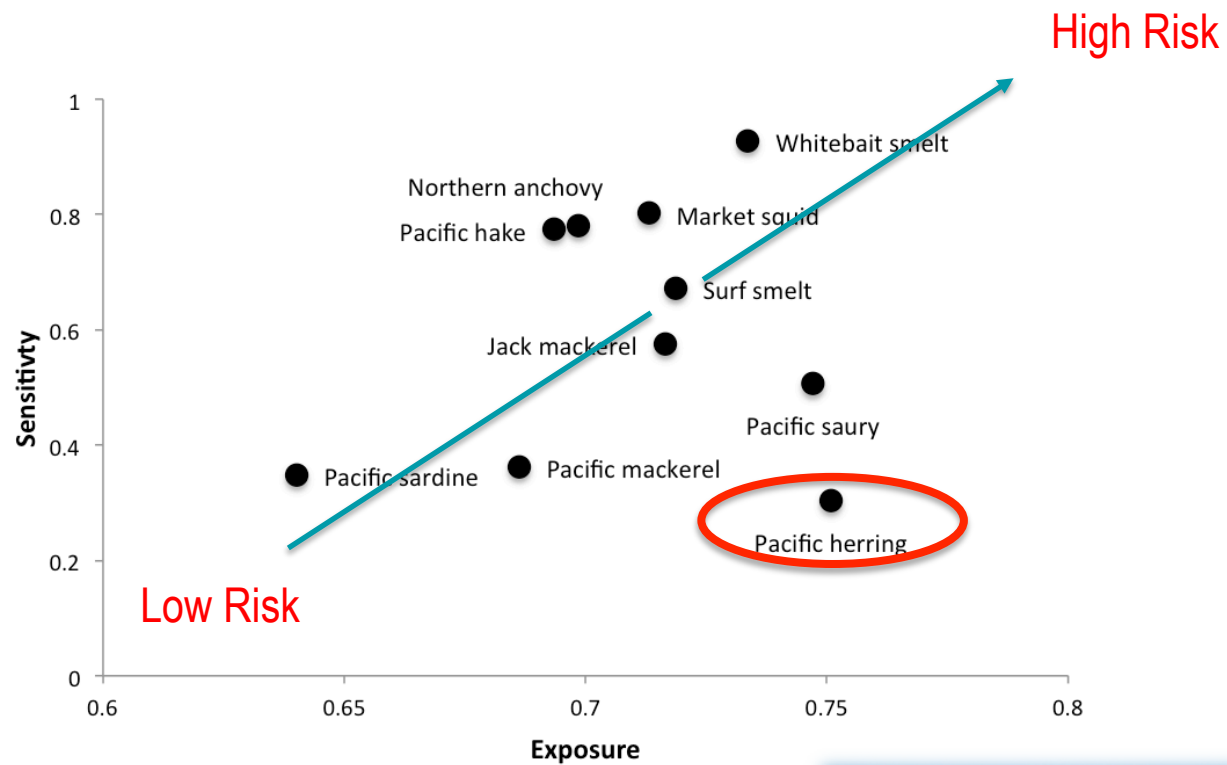


VS.



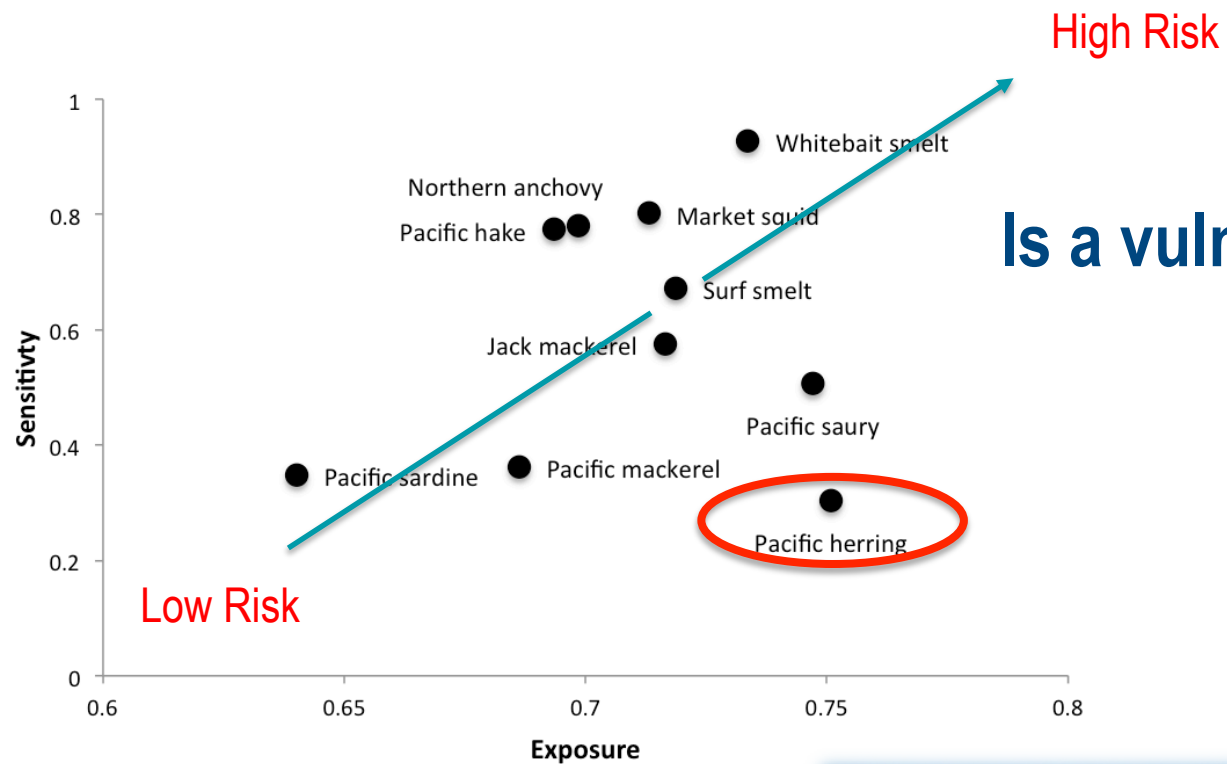
5 Estimate sensitivity based on climatic breadth

COASTAL PELAGIC SPECIES CLIMATE VULNERABILITY IN THE CCLME



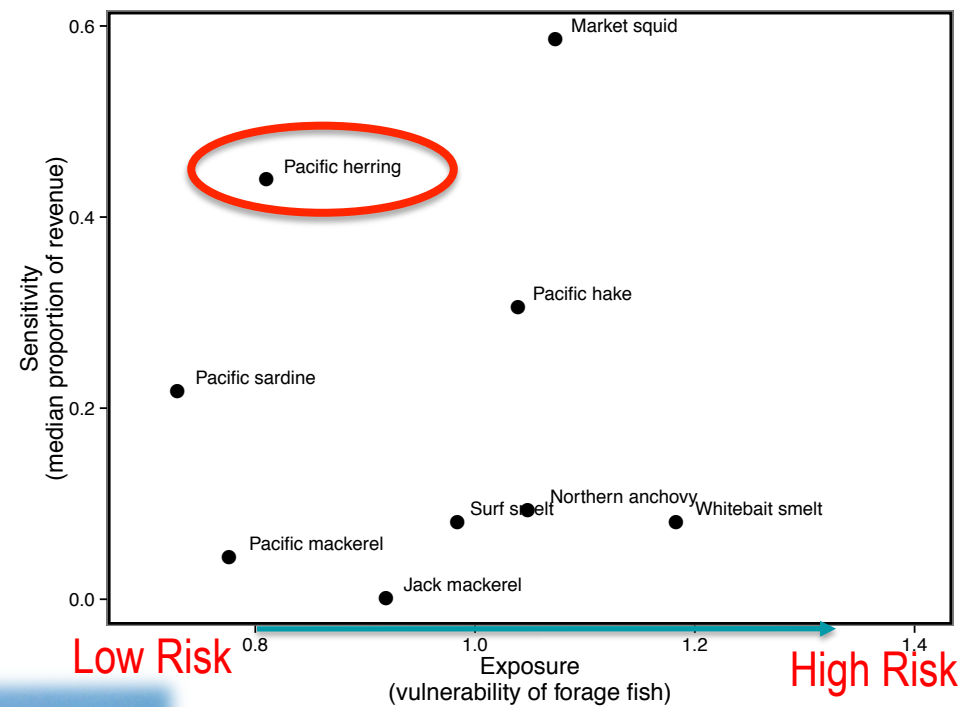
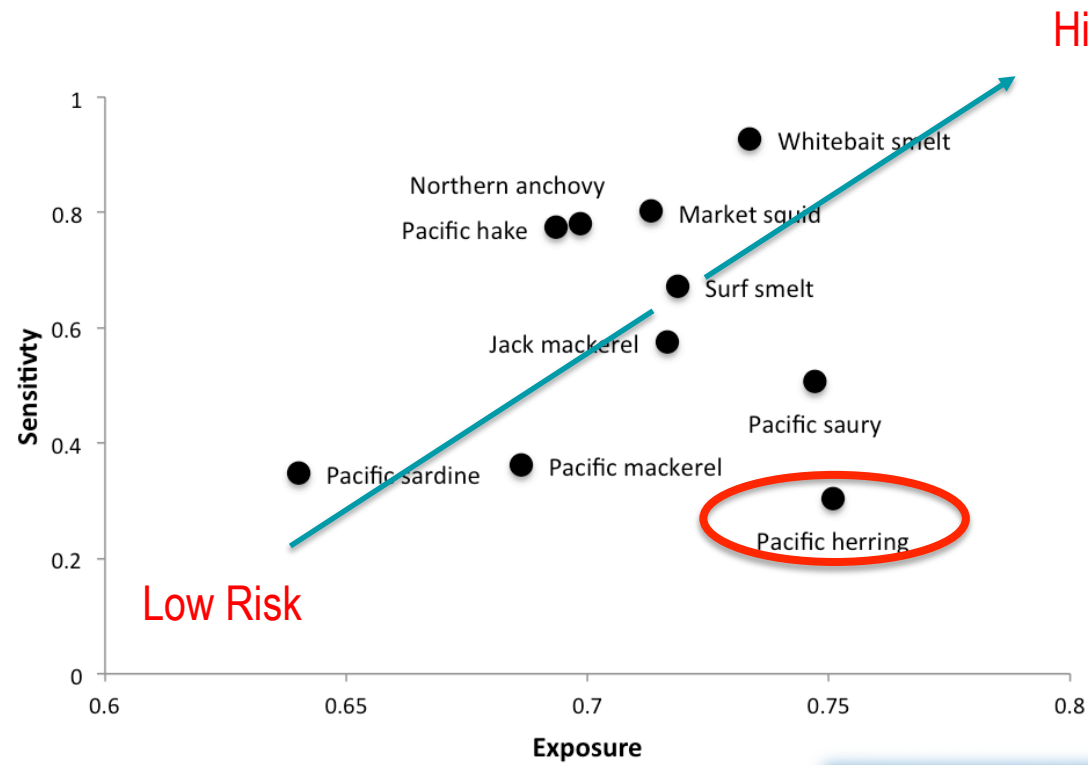
Samhuri, Jacox, Hazen, Bograd (in prep)

COASTAL PELAGIC SPECIES CLIMATE VULNERABILITY IN THE CCLME



Samhuri, Jacox, Hazen, Bograd (in prep)

COASTAL PELAGIC SPECIES CLIMATE VULNERABILITY IN THE CCLME

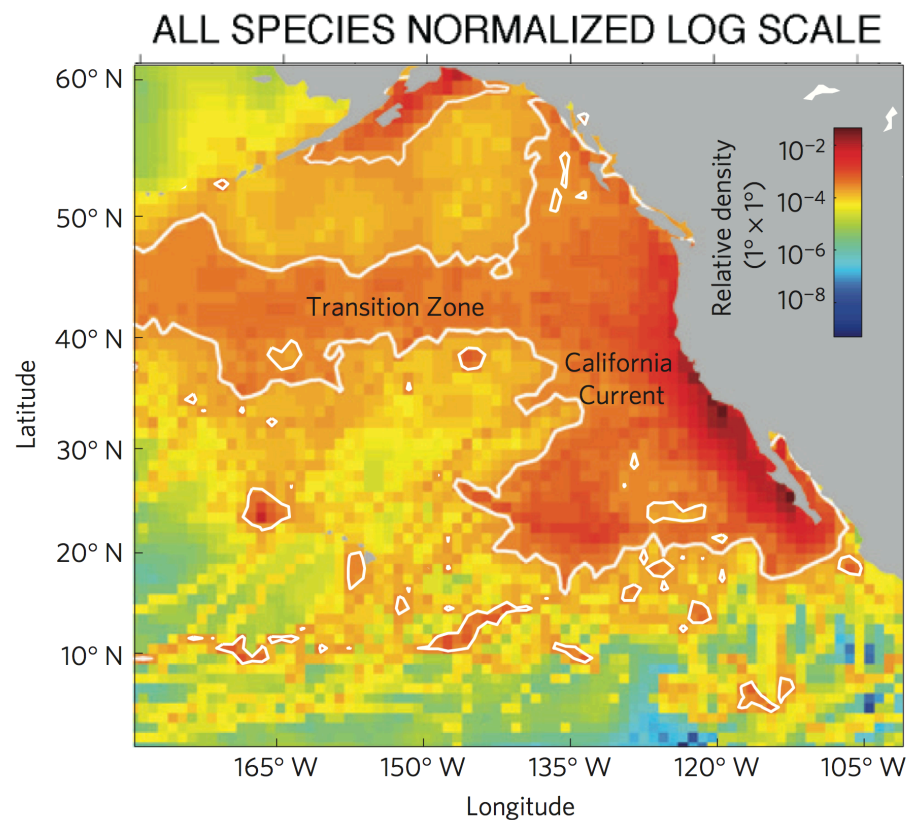


Samhuri, Jacox, Hazen, Bograd (in prep)

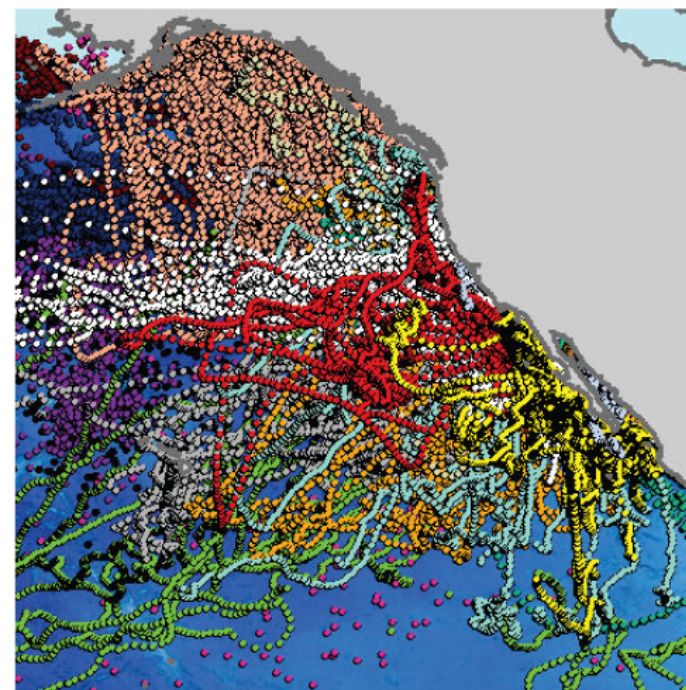
HIGHLY MIGRATORY SPECIES CLIMATE VULNERABILITY IN THE NORTH PACIFIC



HIGHLY MIGRATORY SPECIES CLIMATE VULNERABILITY IN THE NORTH PACIFIC



All Species All Positions

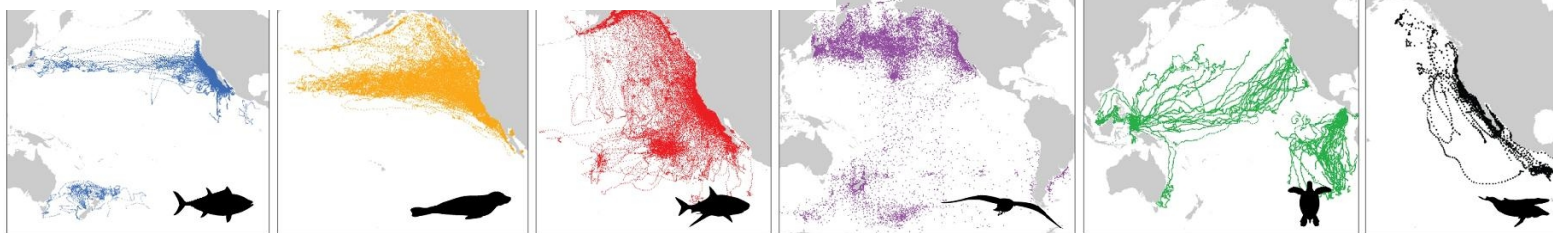


Block et al. (2011)

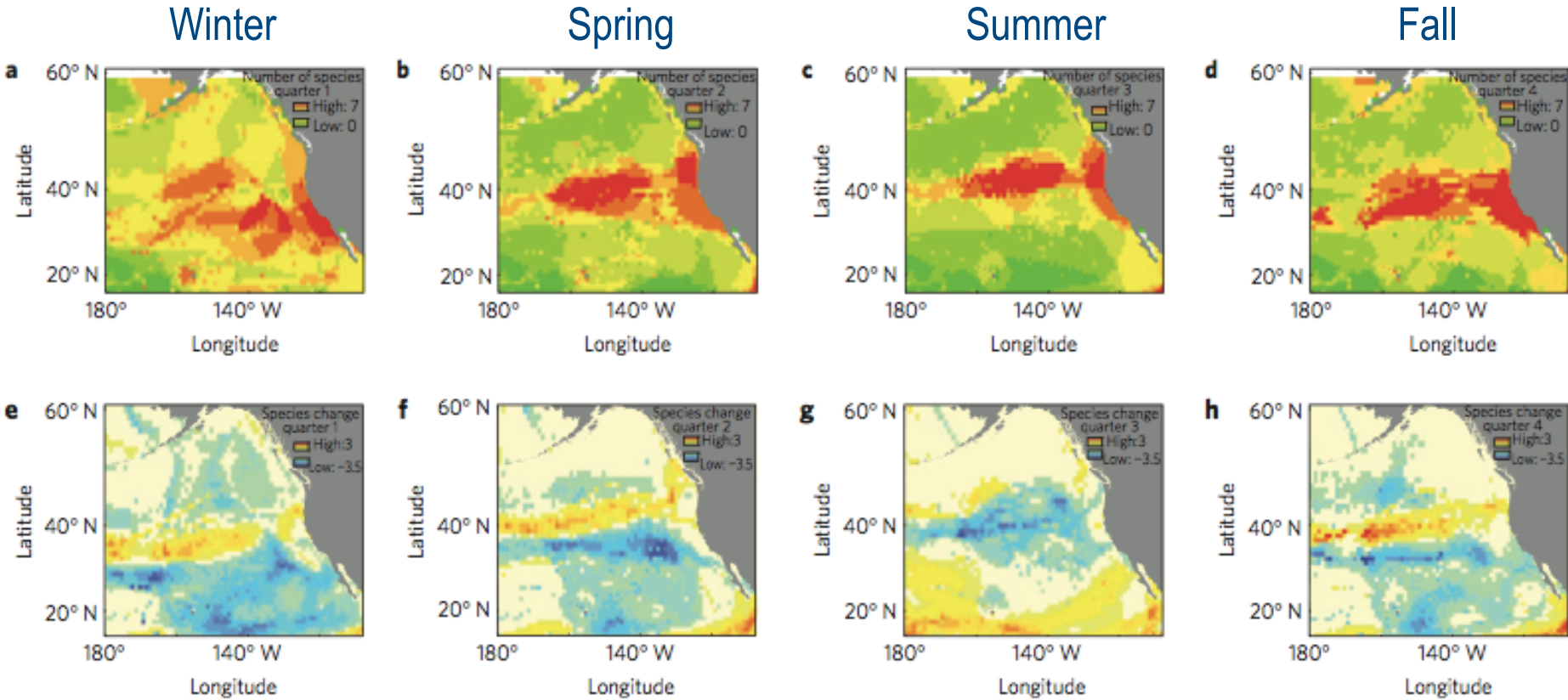
- 23 species
- 4,300 tags
- 300,000 tracking days
- >1M profiles



TAGGING OF
PACIFIC
PREDATORS



HIGHLY MIGRATORY SPECIES CLIMATE VULNERABILITY IN THE NORTH PACIFIC



Current
Species
Richness

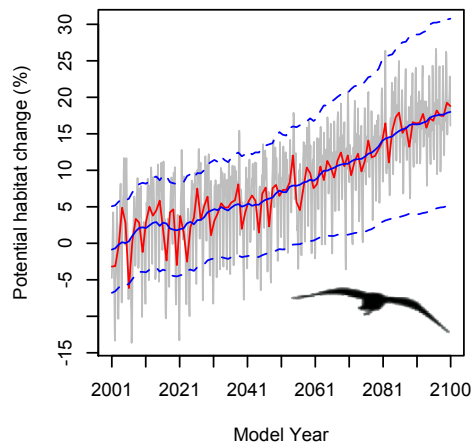
Change in
21st Century
(GFDL ESM)

Figure 3 | a-h, Quarterly modelled species richness for 2001-2010 from 15 top predator species (a-d) and predicted changes in species richness over the next century (2001-2020 compared with 2081-2100) (e-h).

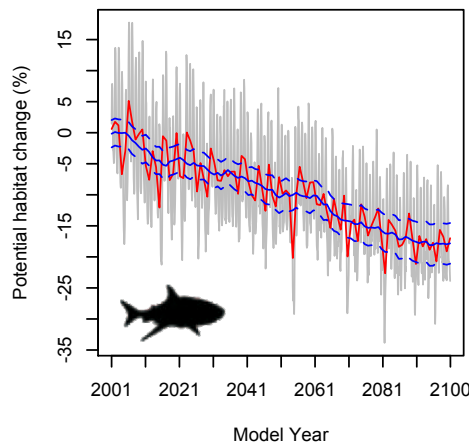
Hazen et al. (2013)

HIGHLY MIGRATORY SPECIES CLIMATE VULNERABILITY IN THE NORTH PACIFIC

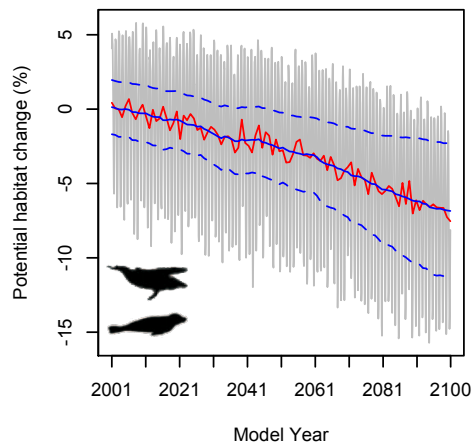
Seabird guild mean core habitat area



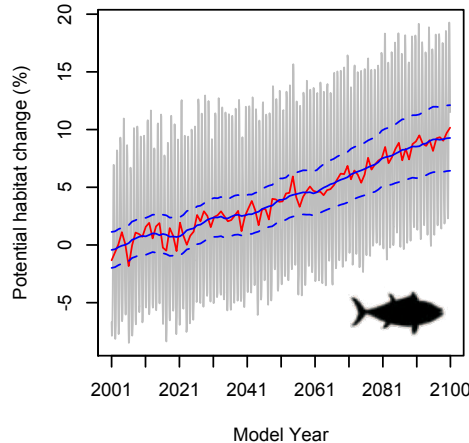
Shark guild mean core habitat area



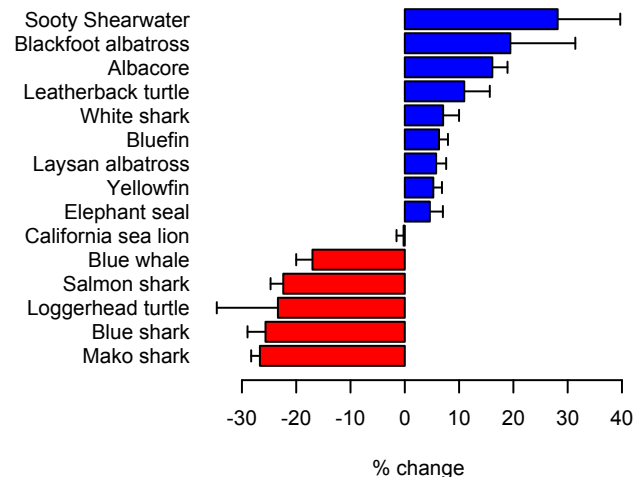
Mammal guild mean core habitat area



Tuna guild mean core habitat area



Habitat Change (2100-2001)

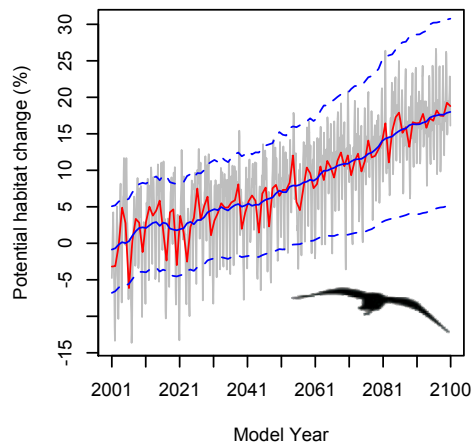


'Winners'

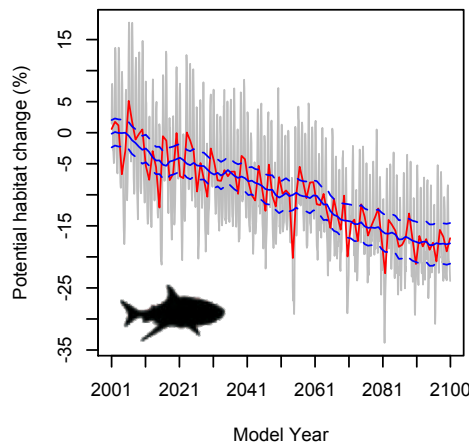
Hazen et al. (2013)

HIGHLY MIGRATORY SPECIES CLIMATE VULNERABILITY IN THE NORTH PACIFIC

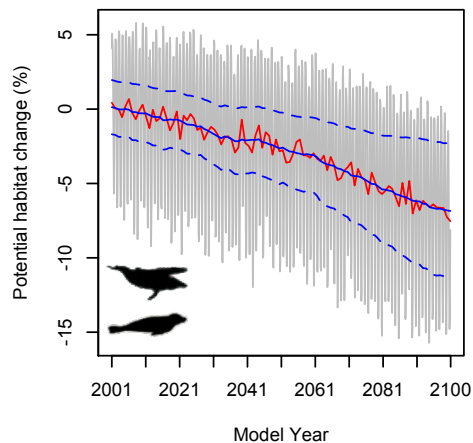
Seabird guild mean core habitat area



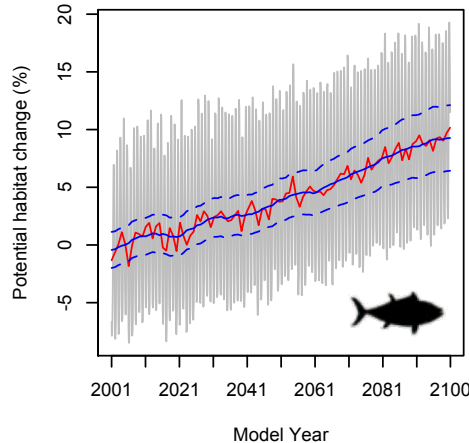
Shark guild mean core habitat area



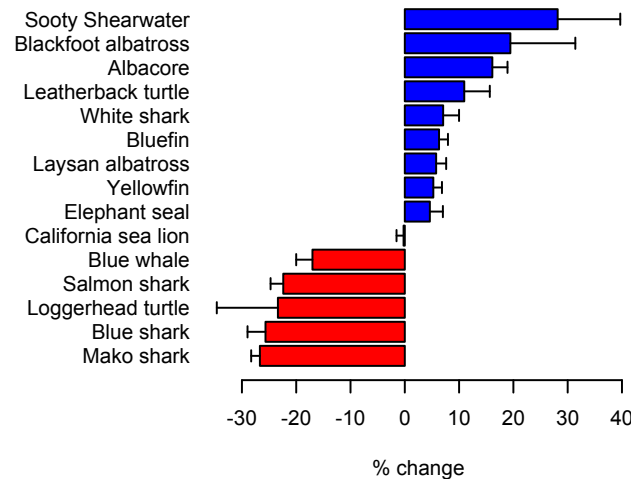
Mammal guild mean core habitat area



Tuna guild mean core habitat area



Habitat Change (2100-2001)



'Winners'

&

'Losers'

Hazen et al. (2013)

CLIMATE VULNERABILITY ASSESSMENTS

Science

- Identify stocks that can benefit from incorporating environmental parameters into stock assessments
- Identify gaps in information for use in shaping research priorities
- Identify stocks that could benefit from increased monitoring to better quantify when expected climate impacts occur

Management

- Provide information for use in EIS's, BiOps and other decision making documents
- Identify potential management actions that might reduce vulnerability and increase stock resilience in a changing climate
- Results can be combined with social and economic data to build vulnerability assessments for fishing communities

Climate Vulnerability Studies: Strengths, Challenges and Strategies

- Strengths

- Strong collaborations within NOAA (OAR-ESRL, GFDL), academic & international partners
- Unified national process to compare amongst regions
- CCLME rich in historical environmental & biological time series

- Challenges

- Need additional resources & mechanisms for cross-Line-Office integration
- Need regional and shorter-term climate projections

- Strategies

- Continued broad & productive collaborations
- Strengthen in-house climate & regional ocean & ecological modeling capacity
- Develop mechanistic-based climate vulnerability studies

Climate Vulnerability Studies: Strengths, Challenges and Strategies

- Strengths

- Strong collaborations within NOAA (OAR-ESRL, GFDL), academic & international partners
- Unified national process to compare amongst regions
- CCLME rich in historical environmental & biological time series

- Challenges

- Need additional resources & mechanisms for cross-Line-Office integration
- Need regional and shorter-term climate projections

- Strategies

- Continued broad & productive collaborations
- Strengthen in-house climate & regional ocean & ecological modeling capacity
- Develop mechanistic-based climate vulnerability studies

Climate Vulnerability Studies: Strengths, Challenges and Strategies

- Strengths

- Strong collaborations within NOAA (OAR-ESRL, GFDL), academic & international partners
- Unified national process to compare amongst regions
- CCLME rich in historical environmental & biological time series

- Challenges

- Need additional resources & mechanisms for cross-Line-Office integration
- Need regional and shorter-term climate projections

- Strategies

- Continued broad & productive collaborations
- Strengthen in-house climate & regional ocean & ecological modeling capacity
- Develop mechanistic-based climate vulnerability studies

Questions?

